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(71) Applicants  
Mitsubishi Denki KK,  
(Japan),  
2-3 Marunouchi 2-chome,  
Chiyodaku,  
Tokyo,  
Japan.  
(72) Inventors  
Akira Morishita  
(74) Agent and/or Address for  
Service  
Marks and Clerk,  
57-60 Lincoln's Inn Fields,  
London WC2A 3LS.

(54) Electric motor

(57) A field device for a DC motor comprises a cylindrical yoke 12, two pairs of magnetic poles 14 formed of a permanent ferrite magnet and disposed at equal angular intervals on the inner peripheral surface of the yoke, and four axial slits 16 radially penetrating the yoke on the centre lines of the magnetic poles respectively. A protective tube 18 is fitted onto the yoke and then shrunk by heating to cover the four slits.

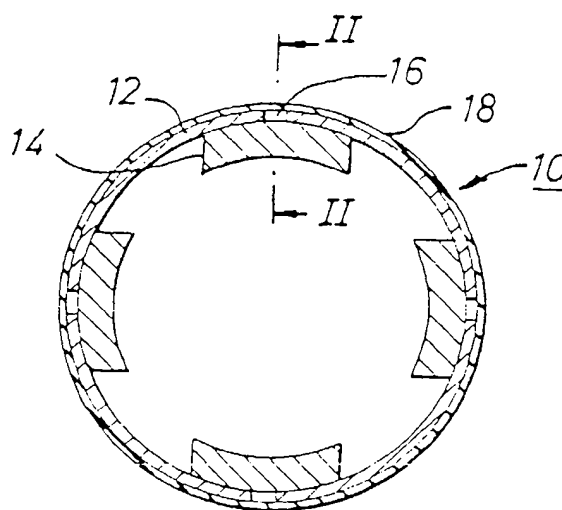


FIG. 1.

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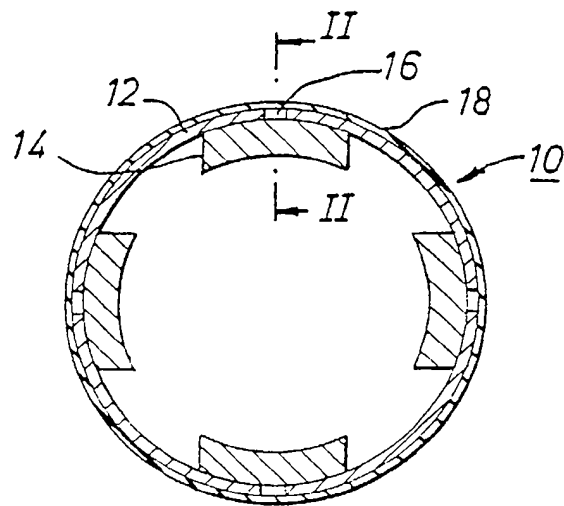


FIG. 1.

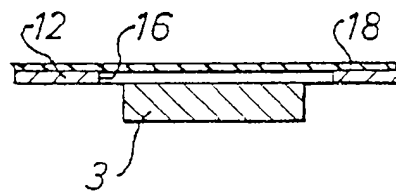


FIG. 2.

## SPECIFICATION

### Electric motor

#### *Background of the invention*

- 5 This invention relates to an electric motor, and more particularly to improvements in an electric motor comprising a cylindrical yoke, a plurality of pairs of magnetic poles formed of a permanent ferrite magnet and fixedly secured to the yoke and a
- 10 plurality of slits disposed on the yoke to interrupt a magnetic flux flowing through the yoke due to an armature reaction one for each of the magnetic poles.

A conventional electric motor of the type referred to has comprised a cylindrical yoke formed of sheet off steel, two pair of magnetic poles formed of a permanent ferrite magnet and fixedly secured at equal angular intervals to the inner peripheral surface of the yoke through a bonding agent and

20 four slits each disposed on the yokes of the central line of the associated magnetic pole to interrupt a magnetic flux flowing through the yoke due to an armature reaction.

Conventional electric motors such as described above have been disadvantageous in that extraneous foreign matters such as water, dust etc. intrude into the interior of the yoke through the slits to contaminate the latter resulting in the deterioration of the reliability thereof.

Accordingly it is an object of the present invention to provide a new and improved electric motor of the type referred to including a yoke whose interior is prevented from contaminating by extraneous foreign matters.

#### 35 *Summary of the invention*

The present invention provides an electric motor comprising a cylindrical yoke, a plurality of pairs of magnetic poles formed of a permanent ferrite magnet and fixedly secured at predetermined equal angular intervals to the inner peripheral surface of the yoke, a plurality of slits axially running on and radially extending through the yoke to be located on the central lines of the magnetic poles one for each of

45 the magnetic pole, and a protective tube of a thermally shrinkable material fitted onto the outer peripheral surface of the yoke to cover the plurality of slits.

#### 50 *Brief description of the drawing*

The present invention will become more readily apparent from the following detailed description taken in conjunction with the accompanying drawing in which:

55 *Figure 1* is a cross sectional view of one embodiment according to the electric motor of the present invention with parts omitted; and

*Figure 2* is a fragmental longitudinal sectional view of the arrangement shown in *Figure 1* as viewed on the line II-II of *Figure 1*.

#### *Description of the preferred embodiments*

Referring now to *Figure 1* of the drawing, there is illustrated one embodiment according to the electric motor of the present invention. The arrangement

illustrated comprises a field device for a DC motor generally designated by the reference numeral 10.

The field device 10 is composed of a cylindrical yoke 12 produced by pressing sheet soft steel, and a plurality of pairs of magnetic poles formed into segments of a permanent ferrite magnet and fixedly secured at predetermined equal angular intervals to the inner peripheral surface of the yoke 12 through a binding agent (not shown). The magnetic poles 14 are identical to one another and include the radially outer and inner surface coaxial with the inner peripheral surface of the yoke 12. In the example illustrated two pairs or four of the magnetic poles 14 are arranged at equal angular intervals of 90 degrees on the inner peripheral surface of the yoke 12 so that the magnetic poles 14 of each pair are diametrically opposite to each other. Then an axial slit 16 axially run on and radially extends through the yoke 12 on the central line of each of the magnetic poles 14.

When an armature (not shown) is externally energized to be rotated with the magnetic excitation of the field device 10, the energized armature exerts a reaction on the yoke 12 having a low reluctance to cause a magnetic flux to flow through the yoke 12.

90 The purpose of the slits 16 is to interrupt a flow of that magnetic flux through the yoke.

That portion of the arrangement as described above is of the conventional structure and has been disadvantageous in that extraneous foreign matters such as water, dust etc. intrude into the interior of the yoke 12 through the slits 16 resulting in the deterioration of the reliability thereof.

The present invention contemplates to eliminate the disadvantages such as described above by the provision of means for closing the slits 16.

As shown in *Figures 1* and *2*, a protective tube 18 is fitted onto the outer peripheral surface of the yoke 12. The protective tube 18 is formed of a thermally shrinkable material selected from the group consisting of polyvinyl chlorides, polyesters and polyolefines and commercially available under "HSIH TUBE" (trade mark), "TERE TUBE" (trade mark) or "SUMI TUBE" (trade mark) from Mitsubishi Jushi firm, Teijin Kasei firm or Sumitomo Denko firm respectively.

After having been disposed on the outer peripheral surface of the yoke 12, the protective tube 18 is shrunk by heating until it completely closes the slits 16.

It has been found that, when the yoke 12 has an outside diameter of from 70 to 80 millimeters and a thickness of from 1.8 to 2.2 millimeters the protective tubes 18 0.1 millimeter thick gives the satisfactory result.

From the foregoing it is seen that, according to the present invention, the protective tube is fitted onto the yoke and then shrunk by heating to close the slits disposed thereon to suppress an armature reaction. Thus the protective tube is effective for preventing extraneous foreign matters such as water, dust, etc. from intruding into the interior of the yoke through the slits resulting in a water proof structure. Therefore the resulting device is water proof thereby to prevent the interior of the yoke from rusting and also to prevent the occurrence of

objections such as the deterioration of the bonding agent for bonding the magnetic poles to the yoke and others. In other words, the field device according to the present invention has the interior prevented from being extraneously contaminated.

While the present invention has been illustrated and described in conjunction with a single preferred embodiment thereof it is to be understood that numerous changes and modifications may be resorted to without departing from the spirit and scope of the present invention. For example, the present invention has been described in conjunction with the yoke including two pairs of magnetic poles formed of a permanent ferrite magnet and fixedly secured on the inner peripheral surface thereof but it is to be understood that the same is not restricted thereto or thereby and that is is equally applicable to electric motors including the yoke provided with slits for preventing an armature reaction from affecting the yoke. Also the yoke may include a plurality other than two of the magnetic pole pairs and therefore a plurality other than four of the slits.

#### CLAIMS

1. An electric motor comprising a cylindrical yoke, a plurality of pairs of magnetic poles formed of a permanent ferrite magnet and fixedly secured at predetermined equal angular intervals on an inner peripheral surface of said yoke, a plurality of slits axially running on and radially extending through said yoke to be located on the central lines of said magnetic poles one for each of said magnetic poles, and a protective tube of a thermally shrinkable material heat fitted onto an outer peripheral surface of said yoke to cover said plurality of slits.
2. An electric motor as claimed in claim 1 wherein said thermally shrinkable material comprises one selected from the group consisting of polyvinyl chlorides, polyesters and polyolefines.

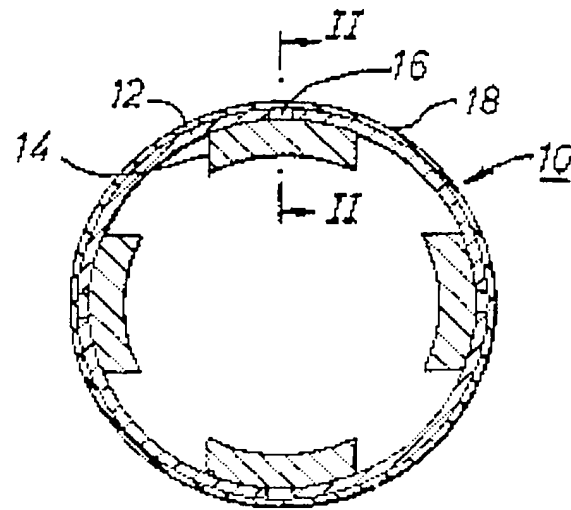


FIG. 1.

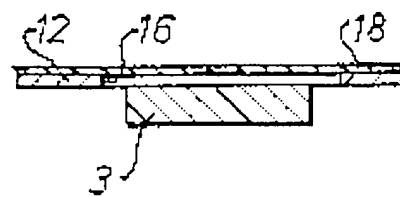


FIG. 2.